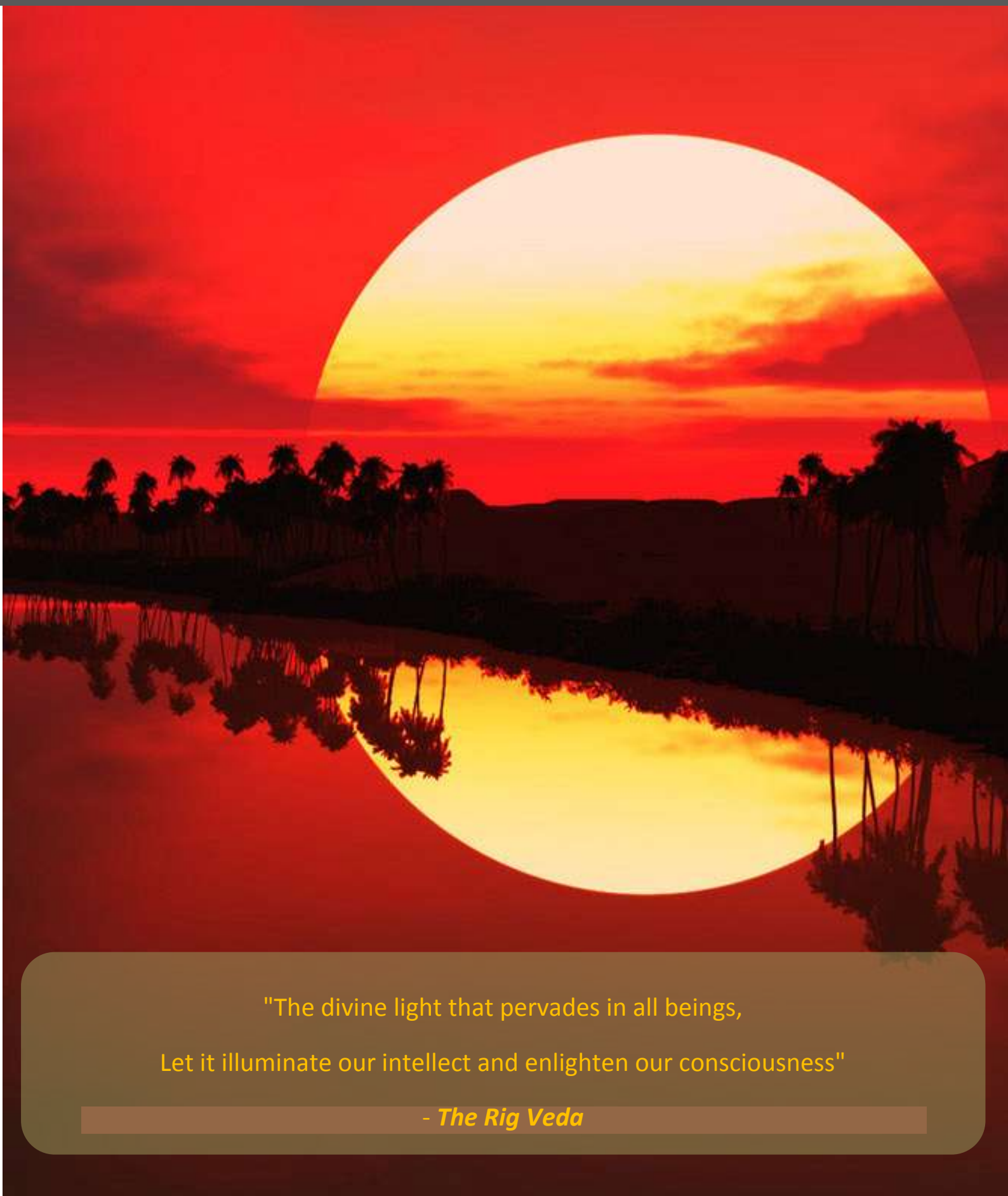
LIFE STREAM

ANNUAL ISSUE 2017-- ENERGY FROM THE SUN



"The divine light that pervades in all beings,

Let it illuminate our intellect and enlighten our consciousness"

- The Rig Veda

THEME: ENERGY FROM THE SUN

CONTENTS

A 1. Nature **Photosynthesis** **Pages 3-7**	**E. Art and Culture** **The Sun Temple at Konark** **Pages 24-26**
A 2. Farming **Crop Calendars and Farming** **Pages 8-11**	**F. Poem** **Ode to the Sun** **Pages 27-30**
B. Economics **The Disruptive power of Solar Energy** **Pages 12-16**	**G. Travel** **Seychelles: Land of the Sun, Sea and Sand** **Pages 31-32**
C. Science **Know your Photons** **Pages 17-19**	**H. Food and Diet** **Sun Foods** **Pages 33-35**
D. Personalities **Goethe's Color Wheel** **Pages 20-23**	**I. Universe** **Beyond the Solar System** **Pages 35-37**

COVER:SUNRISE **(image Credit: pinterest.com)**

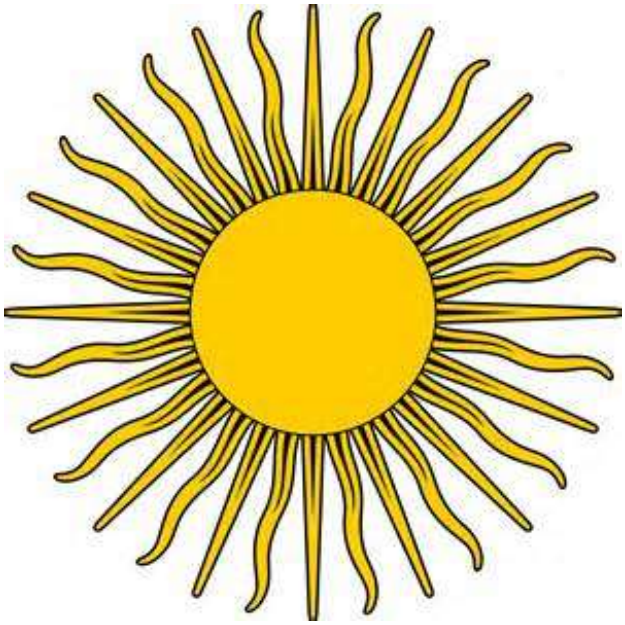
LIFE STREAM ANNUAL ISSUE 2017 IS A PUBLICATION OF THE LIFE SCIENCE FOUNDATION

WE PRESENT

The glowing presence of the Sun is a constant reminder to us of the power of natural forces. Our ancestors worshiped the Sun God, as they considered the Sun as their life giver. Even today different cultures worship the Sun. Some say that the Sun is the only God visible to humans!

Through the centuries the Sun has influenced every aspect of our lives, including our food and agriculture, science and poetry, as well as art and architecture. However, we are not conscious of the myriad processes in nature sparked of by the Sun's rays which make our lives possible in this world. The invisible and silent process of photosynthesis that uses solar energy has sustained all forms of life on this earth.

In a crisis we are forced to go back to nature for solace. Today, with deepening ecological crisis, men are forced to look for sustainable alternatives. Solar energy has started taking over as a viable alternative to non renewable fossil fuels. As such, a solar revolution, which can dramatically change the way we live, is predicted by knowledgeable sources.



It is exciting to note that there are solar systems in the universe that exist beyond our own solar system.

The Sun being central to our lives, we decided to dedicate this issue of Life Stream to the Sun and solar energy. As is our practice, we have collected information from various sources, the interner, electronic and printed media, books and periodicals and put them together, to facilitate you to enhance your understanding of the subject. We do hope that we are successful in our endeavor.

We present here the ***Annual Issue of Life Stream, 2017on the Energy from the Sun.***

LIFE STREAM TEAM

"Keep your face to the sun and you will never see the shadows."
— Helen Keller

NATURE: PHOTOSYNTHESIS

The Sun is the primary source of energy for most life on earth. But how does this energy get transferred to the biosphere? If Nature could be imagined as a vast kitchen, the plants and certain other organisms like algae and bacteria 'cook' organic compounds with the help of energy from the Sun, using carbon dioxide and water, in specialized membranes/organelles located in the leaves or in their bodies by a process called photosynthesis. What we see with our naked eye is only the sunlight falling on the deep green of the leaves; not the silent, underlying process in which streams of photons from sunlight hit the leaf surfaces that trigger a process of exiting and release of electrons in a series, making the leaves pulsate with energy. To imagine that this energy is the life giver on earth evoke a feeling of awe and humility in us. In this article we discuss how, where and why photosynthesis occurs in nature and what its impact on human life is.

PHOTOSYNTHESIS

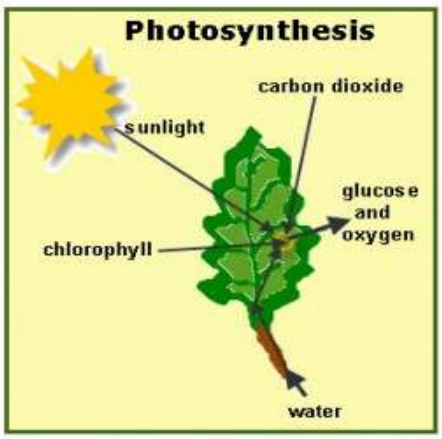


Figure 1. Photosynthesis

What is photosynthesis? The name photosynthesis is derived from the Greek phōs, "light", and synthesis, "putting together". In this process plants and certain other organisms like algae and Cayano-bacteria convert light energy from the Sun into chemical energy which is stored as carbohydrate molecules, such as sugars, which are synthesized from carbon dioxide and water. Oxygen in most cases is released as a waste product.

> It is more than a figure of speech to say that plants create life out of thin air."
>
> **--Michael Pollan-**

HISTORY

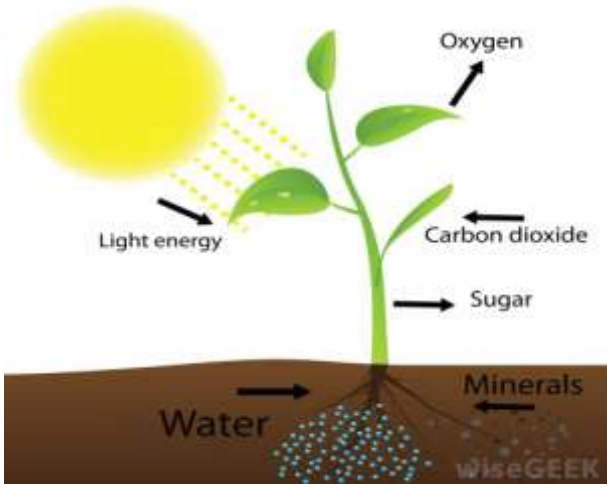


Figure 2. The Cycle

Photosynthesis has a unique place in the history of biology (see box).The studies on photosynthesis began with the discovery of oxygen by the English scientist Joseph Priestly. It took almost half a century to the discovery (in 1845) that light energy from the sun is stored as chemical energy in products formed during photosynthesis.

THE MECHANISM OF PHOTOSYNTHESIS

- Photosynthesis is a highly regulated, multi-step process involving numerous reactions catalyzed by enzymes.
- At the molecular level photosynthesis is an oxidation–reduction process (removal of electrons from a molecule; gain of electrons by another), energized by light.
- Although photosynthesis is performed differently by different species,

the process always begins when energy from sunlight is absorbed by proteins called reaction centers that contain green pigments called chlorophyll .

- In plants, these proteins are located in organelles called chloroplasts, which are most abundant in leaf cells, while in bacteria they are found in the plasma membrane.
- The process of photosynthesis involves two stages. The first part is called the **light stage (Phase-1).** In this stage light energy from the sun is captured which triggers a series of electron transfers. These result in the synthesis of Adenosine Tri Phosphate (ATP) and Nicotine Adenine Di-nucleotide phosphate (NADPH).
- In the second stage of the process (phase-2) the **dark or light independent stage** the ATP and NADPH formed in Phase-1are used to reduce carbon dioxide to organic carbon compounds. (ref: www.britanica.com)

WHAT IS THE CALVIN CYCLE?

It is one of three metabolic pathways for carbon fixation in photosynthesis, along with other pathways called C_4 and CAM. Carbon dioxide is captured in a cycle of reactions known as the Calvin cycle. The cycle was first observed by Melvin Calvin in Chlorella, an unicellular algae. This cycle involves processes concerning conversion of carbon dioxide and Ribulose bi phosphate (RuBP- a 5-carbon sugar) into 3-phosphoglycerate.

This reaction is catalyzed by an enzyme called RuBisCo, which is said to be the most abundant organic molecule on earth. *As 3-carbon molecule is the first stable product of photosynthesis, this cycle is called* ***the C_3 cycle*** and those plants that utilize only the Calvin cycle for carbon fixation are known as C3 plants.**C_3** plants thrive in areas where intensity of

How the Idea Developed

The study of photosynthesis began in 1771, with observations made by the English scientist Joseph Priestley. He burned a candle in a closed container until the air within the container could no longer support combustion. He then placed a sprig of mint plant in the container and discovered that after several days the mint had produced some substance (later recognized as oxygen) that enabled the confined air to again support combustion.

In 1779 the Dutch physician Jan Ingenhousz showed that the plant had to be exposed to light if the combustible substance (i.e., oxygen) was to be restored. He also demonstrated that this process required the presence of the green tissues of the plant.

During this period Jean Senebier, a Swiss botanist and naturalist, discovered that CO2 is required for photosynthesis. Nicolas- Theodore de Saussure, a Swiss chemist and plant physiologist, showed that water is also required.

In1845 Julius Robert von Mayer, a German physician and physicist, proposed that photosynthetic organisms convert light energy into free chemical energy.

In 1782 it was demonstrated that the combustion-supporting gas (oxygen) was formed at the expense of another gas, or “fixed air,” which had been identified the year before as carbon dioxide.

In 1804 it was shown on the basis of experiments that the gain in weight of a plant grown in a carefully weighed pot resulted from the uptake of carbon absorbed as carbon dioxide, and water taken up by plant roots; the balance is oxygen, released back to the atmosphere. *(courtsey: encyclopedia britannica.com)*

The only species on the planet that can actually trap it (CO2) for us in a natural process of photosynthesis are trees

- **Wangari Maathai** -

sunlight and thetemperatures are moderate and carbon dioxide concentrations are around 200 ppm or higher, and groundwater is available in plenty. The C_3 plants are believed to have originated during Mesozoic and Paleozoic eras, predating the C_4 plants. C3 plants represent approximately 95 % of Earth's plant biomass. Examples of C3 plants include rice and barley.

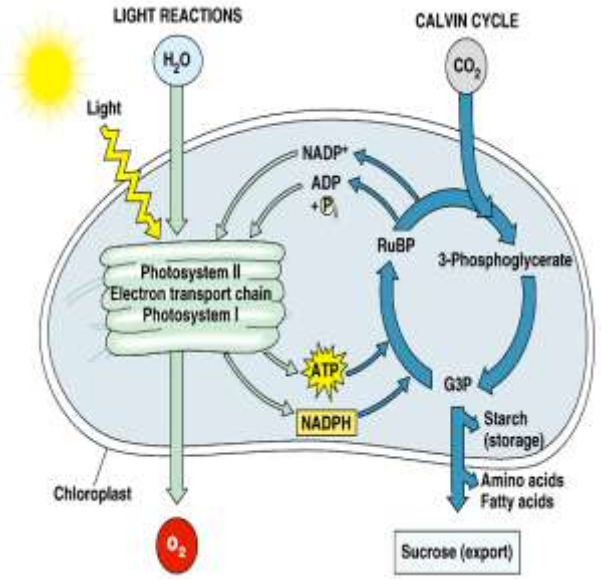


Figure 3. Schematic of light reaction and Calvin cycle

C4 CYCLE (HATCH AND SHACK CYCLE)

Named after Hatch and Shack who discovered it in 1966, the C4 cycle is the alternate path way of C3 cycle taking place during the dark phase of photosynthesis. The first stable compound formed in this cycle is a 4 carbon compound namely Oxalo-acetic acid (OAA). Hence it is called the C-4 cycle.

There are important differences between C3 and C4 cycles in photosynthesis some of which are listed in the box below.

The C_4 photosynthetic carbon cycle is considered to be 'an elaborated addition to the C_3 photosynthetic pathway'. It evolved as an adaptation to high light intensities, high temperatures, and dryness. C_4 plants dominate grassland floras and biomass production in the warmer climates of the tropical and subtropical regions.

C_3 plants lose reportedly 97% of the water taken up through their roots to transpiration. C_4 plants therefore have a competitive advantage over C3 plants as they can thrive in adverse conditions like drought, high temperatures, and nitrogen or CO_2 limitation. When grown in the same environment, at 30 °C, C_3 grasses lose approximately 833 molecules of water per CO_2 molecule that is fixed, whereas C_4 grasses lose only 277. This increased water use efficiency of C_4 grasses means that soil moisture is conserved, allowing them to grow for longer in arid environments. About 7,600 plant species use C_4 carbon fixation, which represents about 3% of all terrestrial species of plants. All these 7,600 species are angiosperms. C_4 carbon fixation is less common in dicots than in monocots, with only 4.5% of dicots using the C_4 pathway, compared to 40% of monocots (ref: Wikipedia)

CRASSULACEAN ACID METABOLISM (CAM) PATHWAY

Also known as **CAM photosynthesis**, this is a carbon fixation pathway that evolved in some plants as an adaptation to arid conditions. This metabolism was first studied in plants of the Crassulaceae family, which mainly include succulents. During the night, a plant having CAM has its stomata open, allowing CO_2 to enter and be fixed as organic acids and are stored in vacuoles. During the day the stomata are closed (thus preventing water loss), and the carbon is released to the Calvin cycle so that photosynthesis may take place.

A big tree seemed even more beautiful to me when I imagined thousands of tiny photosynthesis machines inside every leaf- **Cynthia kenyon**

C3 Cycle	C4 Cycle
C3 cycle operates in all plants.	C4 operates only in C4 plants.
First stable product is a 3-carbon compound.	Primary Co2 acceptor is Phosphophenol Pyruvic acid (PEP)-a 3-carbon compound.
The carboxalte enzyme is Rubisco	The carboxylase enzyme is PEP carboxylase and Rubisco.
Single CO2 fixation	Two CO2 fixation.
Co2 fixation is slow and less efficient	CO2 fixation is fast and far more efficient
Fixation of one molecule of CO2 requires 3 ATP and two NADH molecules.	Fixation of one molecule of CO2 requires 05 Q ATP ıd 3-NADH.
Only granule type of chloroplast involved	Granular and bundle sheath of chloroplasts are i volved.
Cannot operate under very low CO2 concentration.	Can operate under very low CO2 concentra ra tion.
O2 has inhibiting effect on photosynthesis.	O2 has no inhibitory effect.
Sunlight reaches saturation point.	Sunlight does not become saturated.
First stable product is 3-phosphoglyceric acid (PGA)	First stable product is a c4 carbon compound O ːalo Acetic Acid (OAA)
Occurs in plants like Mango/Apple	Occurs in plants like maize and Sorghum-

leave most leaf stomata closed during the day.

A plant of the Crassulaceae family (en.wikipedia.com)

The most important benefit of CAM to the plant is the ability to

When you think about the complexity of our natural world- for e. g. plants using quantum mechanics for photosynthesis, a smart phone begins to look like a pretty dumb object ----**Jeff Vander Meer**

Advantages of photosynthesis

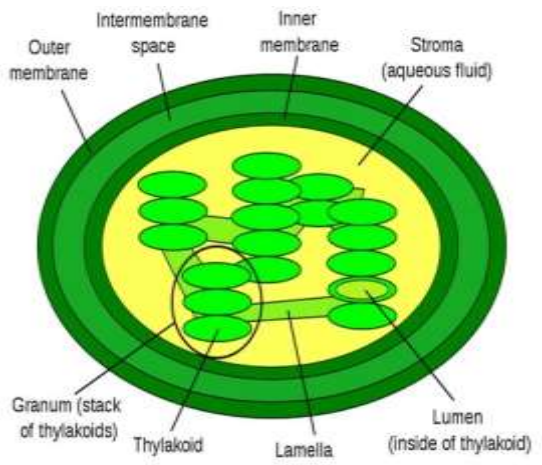
- Photosynthesis can be considered the ultimate source of life for nearly all plants and animals by providing the source of energy that drives all their metabolic processes.
- **photosynthesis** helps in maintaining a balanced level of oxygen and carbon dioxide in the atmosphere.
- Almost all the oxygen present in the atmosphere can be attributed to the process of photosynthesis. Also, the chemical energy stored in plants is transferred to animal

and humans when they consume plant matter.

- According to *www.**life**.illinois.edu* the amount of CO2 removed from the atmosphere each year by oxygenic photosynthetic organisms is massive. It is estimated that photosynthetic organisms remove 100 x 1015 grams of carbon/year (Houghton and Wood well, 1990),
  which is roughly 0.1% of the incident visible radiant energy incident on the earth/year.
- Rare fossil fuels like coal, petroleum and natural gas are formed through the degradation of the past plant and animal parts, which were originally formed by photosynthesis.
- Plant products like timber, rubber, herbs, medicines resin and oils are derived from photosynthesis.
- Photosynthesis decreases the concentration of carbon dioxide and other harmful industrial wastes that lead to respiration problems in living beings.

WHAT ARE CHLOROPLASTS?

CHLOROPLAST- BASIC STRUCTURE (WWW.SCIENKIDS.CO.NZ)



Chloroplasts visible in the cells of Plagiomnium affine, Wikipedia

Tomato Chloroplast, TEM www.sciencephoto.com

Chloroplasts *are the sites of photosynthesis in the leaves. They are one of the many different types of organelles found in the cell. Their main role is to conduct photosynthesis. But they do carry out a number of other functions, including synthesis of fatty acids and amino acids, and the immune response in plants.*

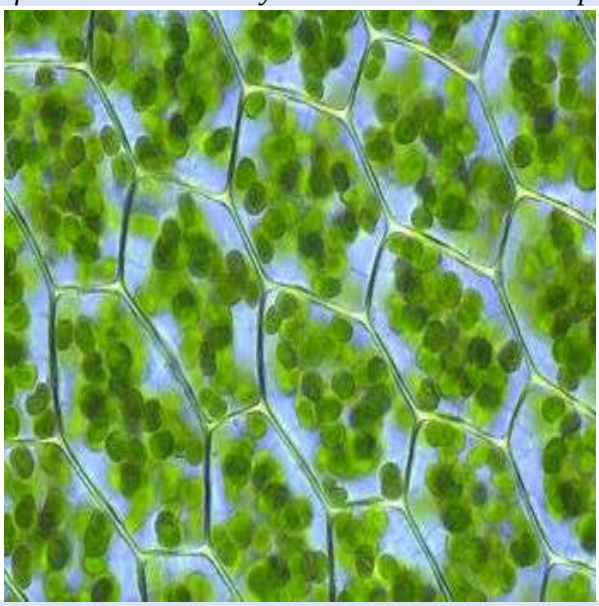
Structure *Each chloroplast is surrounded by an outer and inner membrane which are semi-permeable. Matrix within the Chloroplast is called* ***stroma****. It contains enzymes that catalyze light*

"Food is simply sunlight in cold storage-

John Harvey Kellog

independent reactions. Accessory pigments, enzymes, electron transport system are also found in the stroma. They also have one or more molecules of small circular DNA. Starch granules/grains and lipid globules are also present. ***Thylakoids*** *are disc shaped structures that are the sites of absorption of light. Light dependent reactions take place here. One* ***thylakoid stack*** *is called a* ***granum****. The area within the thylakoids is known as Lumen. Green pigments called Chlorophylls are located within the thylacoids. The stacks of thylakoid sacs are connected by* ***stroma lamellae****. The lamellae act like the skeleton of the chloroplast, keeping all of the sacs a safe distance from each other and maximizing the efficiency of the organelle.*

Chlorophyll *molecules are located on the surface of each thylakoid and capt*



ure light energy from the Sun. As energy rich molecules are created by the light-dependent reactions, they move to the stroma where carbon (C) can be ***fixed*** *and sugars are synthesized. (Ref.www.ivyroses.com)*

Research Given the advantages of C_4, a group of scientists from institutions around the world are reported to be working on the C_4 Rice Project to turn rice, a C_3 plant, into a C_4 plant. As rice is the staple food for more than half of world's population this could have significant global benefits which could enhance food security.. It is further reported that researchers have already identified genes needed for C_4 photosynthesis in rice and are now looking towards developing a prototype C_4 rice plant. In 2012, the Government of the United Kingdom along with the Bill & Melinda Gates Foundation provided $14 million over 3 years towards the C_4 Rice Project at the International Rice Research Institute, Manila.

Phase-1 and Phase-11 of the project involved large scale screening of rice varieties. phase-111 (2015-19) had emphasised on integrated approch to biology. The fourth phase aims to develop a prototype for C_4 metabolism. The Gates Foundation awarded a $15 million grant to the University of Oxford for Phase IV.

The same efforts could be made in respect of other crops too which could impact global food production.

"Ô, Sunlight! The most precious gold to be found on Earth."

Roman Payne

FARMING: SUN CALENDERS

(The Aztec calendar**)**

One of the important developments in human history was the transition from nomadic to settled life. In their new settled life, in order to carry out agricultural operations, it became necessary for early humans to develop a system of demarcating agricultural seasons. The Sun played an important role in the life of people in ancient times. They watched in awe and fascination the movements of the heavenly bodies, especially the Sun and the Moon across the skies. They made keen observations of nature and natural phenomena and observed correlation between their movements with the onset of seasons and their influence on crop production. In this article we discuss what are agricultural calaneders , how they were developed in different parts of the world and what were their benefits.

Planting of crops is an activity that is closely linked to the seasons. Farmers of earlier times did not know how to calculate the perfect time to plant their crops. To predict planting and harvesting times, people in ancient times developed both astronomical and crop calendars. Humans thus began to observe the passage of Sun/Moon through a fixed point and developed crop calendars. Thus crop calendars became an integral part of agriculture as it developed through centuries. Today it is amazing to think that these crop calendars could truly connect the earth and the heavens!

To begin with, all ancient calendars were lunar calendars. The practice of starting a month at the first sighting of a new moon was observed not only by Romans, but also by Celts and Germans in Europe and by Babylonians and Hebrews in the Lavant. The new moons were sighted after either 29 or 30 days. If clouds obscured vision on the 29th day, that month was declared to have 30 days. This is still done for the Islamic Calendar.

When human civilization excelled in agriculture, there was again a need for having a calendar (solar calendar) that repeats the seasons so that it would help sowing and harvesting on repeated calendar dates. This calendar was established based on rotation of the earth around the sun. Early estimates of this rotation was 360 days, so the first solar calendar was invented having 12 months of 30 days each. Some civilizations invented a luni-solar calendar which basically had lunar months based on new crescent moons, but were adding days or a month to be decided by priests wherever and whenever they felt to satisfy social and religious needs to keep their calendar in phase with seasons. This practice of adding days or a 13th month was called "Intercalation". All calendars began with **people recording time by using natural cycles: days, lunar cycles (months), and solar cycles (years).**

CROP CALENDERS

Different cultures developed their own calendars to aid farming in their own unique ways. **Babylonian Calendar:** Around 1800 B.C. Babylonians were using strictly lunar calendar based on the visible new crescent, but somewhere between 1100 B.C and 800 B.C. a luni-solar calendar was adopted Some sources report that during the reign of the Babylonian king Nebuchadenezzar II (630 B.C. - 562 B.C.) priest/experts discontinued their practice of looking for the new moon and adopted a 365 day calendar of 12 months of 30 days each, with five days added at the end of the year.

Hindu Calendar: Hindus developed both solar and luni-solar calendars. In the Hindu solar calendar a month is 30 or 31 days and begins on the day of first

The Sun is new each day

-- Heraclitous

sunrise after the calculated time of the mean sun's entry into the next zodiacal sign. In the Hindu luni-solar system months follow the lunar cycle and are synchronized with the solar year by introducing occasional leap months. In south-India months begin at new moon while in north-India months begin at full moon.

Chinese Calendar: Chinese also started using a luni-solar calendar with months beginning on the day of the new moon. Years contain 12 or 13 such months , with the number of months determined by the number of new moons between successive winter solstices. There have been more than 50 calendar reforms since its inception in the 14th century B.C.

Egyptian Calendar: In order to device a solar calendar in ancient times, experts observed that Sirius, brightest of all the fixed stars, appeared in summer, rising above horizon just before sunrise. They also noticed that Sirius would return to its position after 365 days. Thus, Egyptians devised a solar calendar built around 365 days. They gave up their practice of looking for the new moon in favor of the solar calendar.

Greek Calendar: By 13th century B.C. Greeks were using a lunar calendar based on the visible new crescent. Later, they also learnt intercalation to bring lunar calendar in phase with seasons and started using luni-solar calendar. Astronomers in 432 B.C. calculated a 19-year luni-solar cycle where moon phases would repeat in the same seasons. This was called "Metonic Cycle" where 19 solar years were equal to lunar 19 years and 7 months. This concept was later adopted by Jewish or Hebrew calendar.

Hebrew Calendar: Hebrew Calendar, developed in the in the mid-fourth century is a luni-solar calendar with months based on new crescent moon, but adding a 13th month every so often to bring their luni-solar calendar in phase with the seasons. It consists of 12 month in a common year and 13 months in a leap year.

Roman Calendar: About seven hundred years before Julius Caeser, Romans were observing some lunar calendar, and were adding days or a 13th month at the end of their calendar year to keep their calendar in phase with seasons.

Julian Calendar: Following his conquest of Egypt in 48 B.C. Roman Emperor Julius Caeser adopted the calendar identical to the Alexandrian Aristarchus' calendar of 239 B.C., that consisted of a solar year of 12 months and of 365 days with an extra day every fourth year. This was a truly solar calendar and was later called, "Julian Calendar" named after him.

Mayan Calandar Some of the most impressive calendars were by the Aztecs. The Aztecs created two calendars, one for farming and another for conducting religious activities. (See Box)

The Classic Mayan civilization of southern Mexico, Guatemala and Belize flourished in the fourth through tenth century CE. They were accomplished astronomers and devised a fascinating calendar system based on number 20. The Mayans used two calendars, a sacred year of 260 days and a vague year of 365 days. Like other Mesoamericans, the Mayans used the sacred year for religious purposes and the vague year for planning agricultural activities. (Ref:- www.eecis.udel.edu)

(www.educatinghumanity.com)

The ancient **Egyptian calendar** was invented over

What we plant in the soil of contemplation, we shall reap in the harvest of action

---- Meister Eckhart

5000 years ago. As noted in www.musesrealm.net 'the ancient Egyptians used two types of calendars to keep track of dates: a civil calendar and a religious calendar. Both the civil and religious calendars were one year in length, each year being made up of 12 months or 30 days each. Each month was divided into three 10-day weeks for a total of 30 weeks per year. The months were grouped together in fours into 3 seasons based on the agricultural cycle. The first season, *akhet*, or inundation was the time when the waters of the Nile would flood their banks and make the land fertile and crops could start to be planted. The next season, *peret*, or growing, was the season when plants would grow and farmers would work in the fields. The last season, *shemu*, or harvest, was the season when the crops would be harvested from the fields'.

Relief depicting a Gallo-Roman harvester (Ref: en.wikipedia.org)

The Greeks used a calendar that was very similar to the Babylonian calendar, but they also had other calendars, an arbitrary calendar with 10 arbitrary months and an agricultural calendar. It is believed that Romulus created the first Roman calendar, which had 10 months in a year, with each month of 30 or 31 days. The Romans also developed a number of calendars, including the Julian calendar. The Jews are also credited with the development of their own unique calendar .

The agricultural calendar traditionally used in regions of **North Africa** is the Berber calendar. It is also known in Arabic as the *fellāḥī* (rustic) or *ʿajamī* (foreign) calendar. It is employed to regulate the seasonal agricultural works, in place of the Islamic calendar, a lunar calendar considered ill-adapted for agriculture, because it does not relate to seasonal cycles.

The **Berber calendar**, is considered to be a surviving form of the ancient Julian calendar, the calendar used in Europe before the introduction of the Gregorian calendar, with month names derived from Latin.

The people called **Himba in Ekambu, Namibia,** living in relative isolation from modernity, measure time by the shifting sun and mark the coming of the New Year with the arrival of seasonal rains.

Today it is difficult for us to imagine that an amazing variety of calendars for marking the seasons were developed by our ancients spread across world; more amazing is the similarity in the underlying principle used in their calculations, although they were physically separated by huge distances. It is equally interesting to note that many of the calendars so developed are still being used by several communities living in different parts of the world.

*(**Note:** Part of this article is taken from an article entitled 'Mathematics , Farming and Crop Calendars' published in an earlier issue of Life Stream. We decided to republish the part concerning crop calendars, keeping in mind its relevance to the theme of thisissue)*

Ref:
*en.wikipedia.org/www.moonsighting.com/evolution. blog.**world**-mysteries.com/*
www.musesrealm.net/www.eecis.udel.edu

Use plants to bring life

---Douglas Wilson

ECONOMICS: THE DISRUPTIVE POTENTIAL OF SOLAR POWER

By David Frankel, Kenneth Ostrowski, and Dickon Pinner

Although solar power will continue to account for a small share of the overall US energy supply, it could well have an outsize effect on the economics of utilities. In Europe, over the last several years, the demand for power has fallen while the supply of renewables (including solar) has risen, driven down power prices, and depressed the penetration of conventional power sources.

The economics of solar power are improving. It is a far more cost-competitive power source today than it was in the mid-2000s, when installations and manufacturing were taking off, subsidies were generous, and investors were piling in. Consumption continued rising even as the MAC Global Solar Energy Index fell by 50 percent between 2011 and the end of 2013, a period when dozens of solar companies went bankrupt, shut down, or changed hands at fire-sale prices.

The bottom line: the financial crisis, cheap natural gas, subsidy cuts by cash-strapped governments, and a flood of imports from Chinese solar-panel manufacturers have profoundly challenged the industry's short-term performance. But they haven't undermined its potential; indeed, global installations have continued to rise—by over 50 percent a year, on average, since 2006. The industry is poised to assume a bigger role in global energy markets; as it evolves, its impact on businesses and consumers will be significant and widespread. Utilities will probably be the first, but far from the only, major sector to feel solar's disruptive potential.

ECONOMIC FUNDAMENTALS

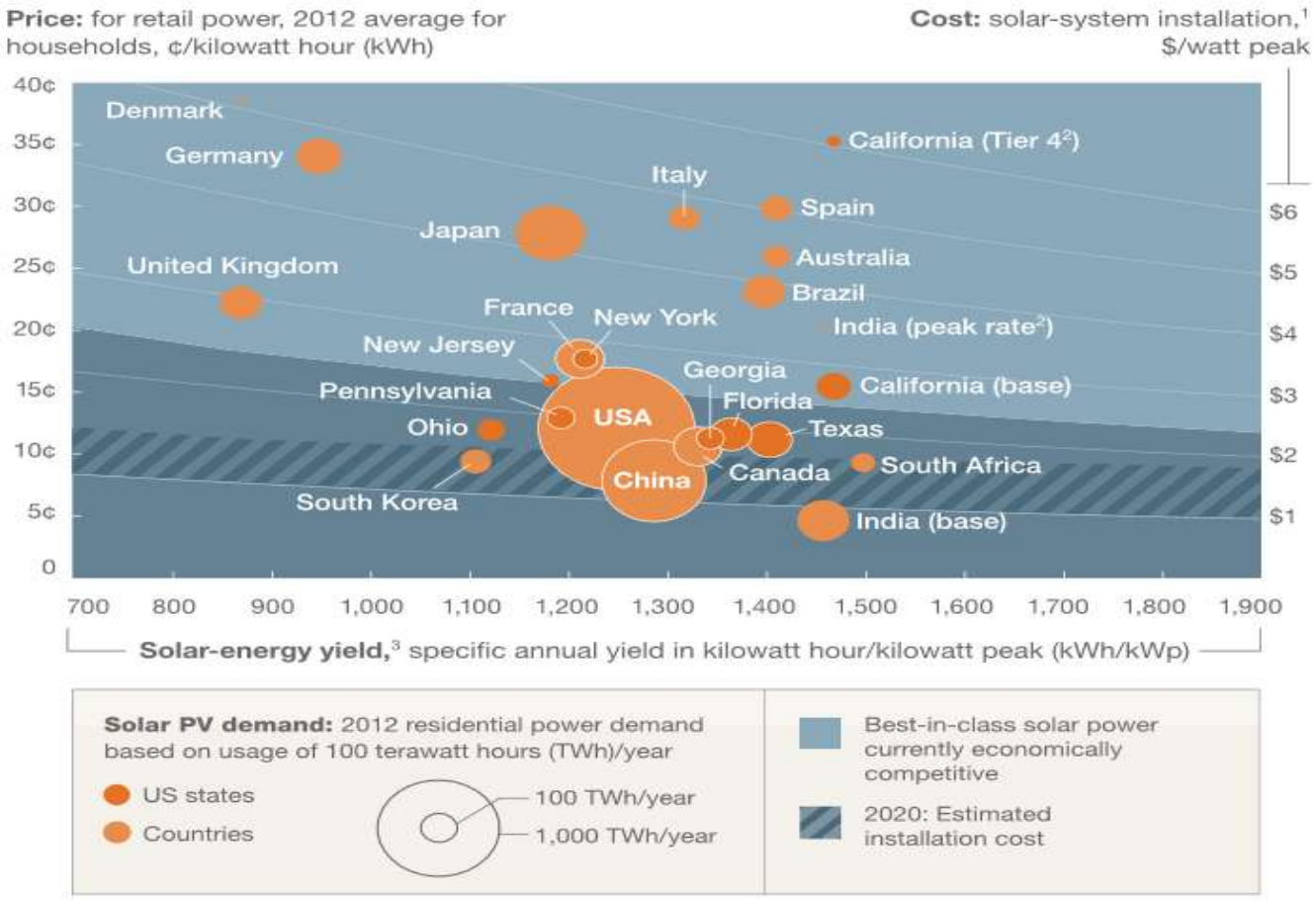
Sharply declining costs are the key to this potential. The price US residential consumers pay to install rooftop solar PV (photovoltaic) systems has plummeted from nearly $7 per watt peak of best-in-class system capacity in 2008 to $4 or less in 2013.1 Most of this decline has been the result of steep reductions in upstream (or "hard") costs, chiefly equipment. Module costs, for example, fell by nearly 30 percent a year between 2008 and 2013, while cumulative installations soared from 1.7 gigawatts in 2009 to an estimated 11 gigawatts by the end of 2013, according to GTM Research.

While module costs should continue to fall, even bigger opportunities lurk in the downstream (or "soft") costs associated with installation and service. Financing, customer acquisition, regulatory incentives, and approvals collectively represent about half the expense of installing residential systems in the United States. Our research suggests that as they become cheaper, the overall costs to consumers are poised to fall to $2.30 by 2015 and to $1.60 by 2020.

"It's really kind of cool to have solar panels on your roof." **Bill Gates**

These cost reductions will put solar within striking distance, in economic terms, of new construction for traditional power-generation technologies, such as coal, natural gas, and nuclear energy. That's true not just for residential and commercial segments, where it is already cost competitive in many (though not all) geographies, but also, eventually, for industrial and wholesale markets. Exhibit 1 highlights the progress solar already has made toward "grid parity" in the residential segment and the remaining market opportunities as it comes further down the curve. China is investing serious money in renewables. Japan's government is seeking to replace a significant portion of its nuclear capacity with solar in the wake of the Fukushima nuclear accident. And in the United States and Europe, solar adoption rates have more than quadrupled since 2009.

Grid-parity potential of solar PV (photovoltaic) power in major markets, residential-segment example



[1]Full cost estimated, based on residential 5-kilowatt c-Si system; levelized cost of energy accounts for solar insulation and assumes 5% weighted average cost of capital, 25-year lifetime, 0.3% annual degradation, and fixed 1% operating and maintenance costs.

[2]California's rate structure charges more for higher consumption; the highest rate ranges from 31–37¢/kWh, depending on the utility. For India, peak rate refers to the rate without an artificial cap, which is imposed to close the peak-power deficit filled by diesel-generated power. Only 2008 data available.

[3]Amount generated by a south-facing 1 kWp module in 1 year (a function of solar intensity).

Source: Enerdata; India Central Electricity Authority; International Energy Agency; Solar Energy Research Center at Lawrence Berkeley National Labs; US Energy Information Administration; US National Renewable Energy Laboratory's PVWatts calculator; McKinsey analysis

A sharp decline in installation costs for solar

Every 24 hours, enough sunlight touches the Earth to provide the energy for the entire planet for 24 years----**MARTHA MAEDA**

photovoltaic systems has boosted the competitiveness of solar power. While these economic power houses represent the biggest prizes, they aren't the only stories. Sun-drenched Saudi Arabia, for example, now considers solar sufficiently attractive to install substantial capacity by 2032, with an eye toward creating local jobs. And in Africa and India, where electric grids are patchy and unreliable, distributed generation is increasingly replacing diesel and electrifying areas previously without power. Economic fundamentals (and in some cases, such as Saudi Arabia, the desire to create local jobs) are creating a brighter future for solar.

BUSINESS CONSUMPTION AND INVESTMENT

Solar's changing economics are already influencing business consumption and investment. In consumption, a number of companies with large physical foot prints and high power costs are installing commercial-scale roof top solar systems, often at less than the current price of buying power from a utility. For example, Wal-Mart Stores has stated that it will switch to 100 percent renewable power by 2020, up from around 20 percent today. Mining and defense companies are looking to solar in remote and demanding environments. In the hospitality sector, Starwood Hotels and Resorts has partnered with NRG Solar to begin installing solar at its hotels. Verizon is spending $100 million on solar and fuel-cell technology to power its facilities and cell-net work infrastructure. Why are companies doing such things? To diversify their energy supply, save money, and appeal to consumers. These steps are preliminary, but if they work, solar initiatives could scale up fast.

As for investment, *solar's long-term contracts and relative insulation from fuel-price fluctuations are proving increasingly attractive.* The cost of capital also is falling. Institutional investors, insurance companies, and major banks are becoming more comfortable with the risks (such as weather uncertainty and the reliability of components) associated with long-term ownership of solar assets. Accordingly, investors are more and more willing to underwrite long-term debt positions for solar, often at costs of capital lower than those of traditional project finance.

Major players also are creating advanced financial products to meet solar's investment profile. The best example of this to date is NRG Yield, and we expect other companies to unveil similar securities that pool renewable operating assets into packages for investors. Google has been an active tax-equity investor in renewable projects, deploying more than $1 billion since 2010. It also will be interesting to track the emergence of solar projects financed online via crowd sourcing (the best example is Solar Mosaic, which brings investors and solar-energy projects together). This approach could widen the pool of investors while reducing the cost of capital for smaller installations, in particular.

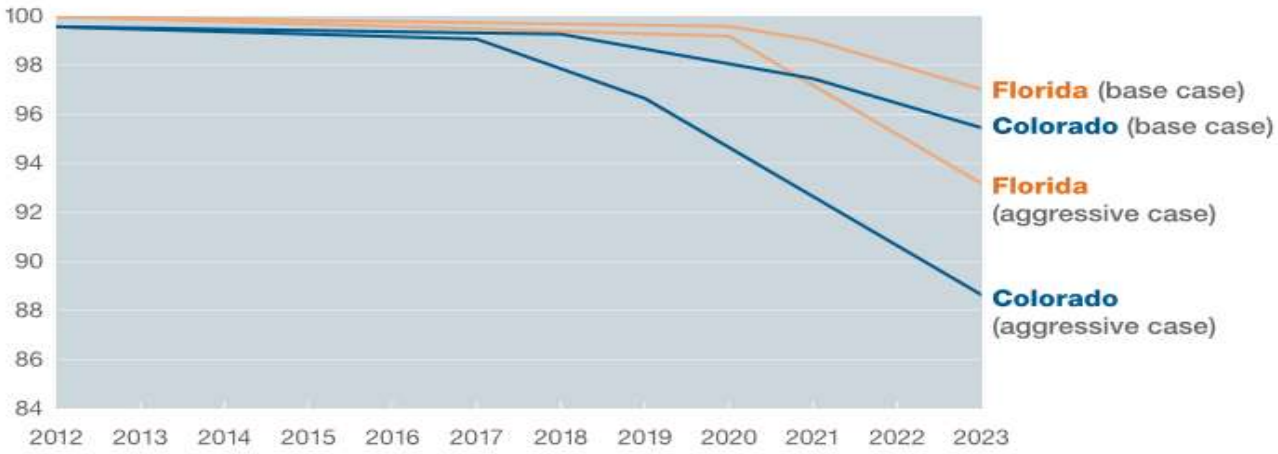
Disruptive potential

The utility sector represents a fascinating example of the potential for significant disruption as costs fall, even as solar's scale remains relatively small. Although solar accounts for only less than half a percent of US electricity generation, the business model for utilities depends not so much on the current generation base as on installations of new capacity. Solar could seriously threaten the latter because its growth undermines the utilities' ability to count on capturing all new demand, which historically has fueled a large share of annual revenue growth. (Price increases have accounted for the rest.)

Solar energy is the last energy resource that is'nt owned yet-nobody taxes the Sun yet

Bonnie Raitt

Remaining electricity consumption from utilities after solar PV (photovoltaic) adoption, both residential and commercial,[1] % of megawatt hours (MWh)



[1]Assumes 8% discount rate, $0.02/watt year in operations and manufacturing costs, 25-year system life; US solar investment tax credit (ITC) expires post 2016 (10% thereafter), Colorado incentive of $0.04/kilowatt hour (kWh) for residential, $0.07/kWh for commercial customers through 2018. Base case assumes 0.05% annual solar PV adoption when levelized cost of electricity (LCOE) is above retail grid electricity prices, and 1% when below. Aggressive case assumes 0.1% and 2%, respectively.

Source: US Energy Information Administration; McKinsey analysis

Depending on the market, new solar installations could now account for up to half of new consumption (in the first ten months of 2013, more than 20 percent of new US installed capacity was solar). By altering the demand side of the equation, solar directly affects the amount of new capital that utilities can deploy at their predetermined return on equity. In effect, though solar will continue to generate a small share of the overall US energy supply, it could well have an outsize effect on the economics of utilities—and therefore on the industry's structure and future (Exhibit 2).

Although solar power will continue to account for a small share of the overall US energy supply, it could well have an outsize effect on the economics of utilities.

That's already happening in Europe. Over the last several years, the demand for power has fallen while the supply of renewables (including solar) has risen, driven down power prices, and depressed the penetration of conventional power sources. US utilities can learn many lessons from their European counterparts, which for the most part stood by while smaller, more nimble players led the way. Each US utility will have to manage the risks of solar differently. All of them, however, will have to do something.

BROADER IMPLICATIONS MANAGEMENT

As solar becomes more economic, it will create new battlegrounds for business and new opportunities for consumers. When a solar panel goes up on a homeowner's roof, the installer instantly develops a potentially sticky relationship with that customer. Since the solar installation often puts money in the homeowner's pocket from day one, it is a relationship that can generate goodwill. But, most important, since solar panels are long-lived assets, often with power-purchase agreements lasting 15 or 20 years, the relationship also should be enduring.

That combination may make solar installers natural focal points for the provision of many products and services, from security systems to mortgages to data storage, thermostats, smoke detectors, energy-information services, and other in-home products. As a result, companies in a wide range of industries may benefit from innovative partnerships built on the deep customer relationships that solar players are likely to own.

The use of solar energy has not been opened up because the oil industry does not own the sun." -- **-Ralph Nader**

Tesla Motors already has a relationship with Solar City, for example, to develop battery storage coupled with solar. It is easy to imagine future relationships between many other complementary players. These possibilities suggest a broader point: the solar story is no longer just about technology and regulation. Rather, business-model innovation and strong management practices will play an increasingly important role in the sector's evolution and in the way it engages with a range of players from other industries. Segmenting customers, refining pricing strategies, driving down costs, and optimizing channel relationships all will figure prominently in the solar-energy ecosystem, as they do elsewhere.

As solar becomes integrated with energy-efficiency solutions, data analytics, and other technologies (such as storage), it will become an increasingly important element in the next generation of resource-related services and of the world's coming resource revolution. In the not too distant future, a growing number of industries will have to take note of the promise, and sometimes the threat, of solar to business models based on traditional energy economics. But, in the meantime, the battle for the customer is taking place today, with long-term ramifications for existing industry structures.

(This article was originally published by McKinsey & Company; reprinted with permission)

Roof-top solar panels (washingtonpost.com)

Solar panel field green hills-California

ABOUT THE AUTHOR(S)

David Frankel is an associate principal in McKinsey's San Francisco office, where **Dickon Pinner** is a principal; **Ken Ostrowski** is a director in the Atlanta office.

The cheapest energy is the energy you don't use in the first place.

-- Sheryl Crow

SCIENCE: KNOW YOUR PHOTONS

Photograph of a flash of light (curtsey:physicsworld.com)

Today we know that photons are the fundamental particles of light and that light is carried over space by photons A photon is described as an elementary particle, the quantum (packets of energy) of all forms of electromagnetic radiation, including light.

HOW THE IDEA DEVELOPED

Light was thought to be made up of particles up to the 18th century. This concept, however, could not account for the refraction, diffraction and birefringence of light. Wave theories of light were proposed by René Descartes (1637), Robert Hooke (1665), and Christian Huygens (1678). Isaac Newton was one of the first scientists to theorize that light consists of particles. Due to his influence particle model remained dominant, in the early nineteenth century.

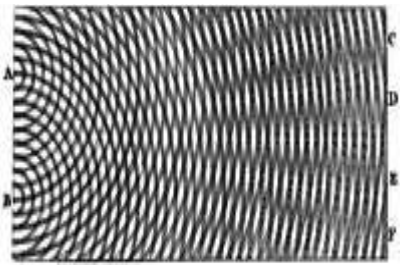
Thomas Young and August Fresnel demonstrated the interference and diffraction of light and by 1850 wave models again gained acceptance. In 1865, James Clerk Maxwell predicted that light was an electromagnetic wave, which was confirmed by in 1888 by detection of radio waves by Heinrich Hertz.

Maxwell's wave theory provided a theoretical model of light but it did not, however, account for *all* properties of light. Several observations could not be explained by any wave model of electromagnetic radiation. Although the theory predicts that the energy of a light wave depends only on its intensity, not on its frequency; several independent experiments showed that the energy imparted by light to atoms depends only on the light's frequency, not on its intensity.

In 1900, the German physicist Max Planck who studied black-body radiation suggested that the energy carried by electromagnetic waves could only be released in "packets" of energy. In his 1901 article in Annalen der Physik he called these packets "energy elements "or quanta (singular quantum) . Later experiments showed that these light-quanta also carry momentum and, thus, can be considered particles. But it was left to Albert Einstein to develop the modern concept of the photon in the early 20th century, to explain experimental observations that did not fit the classical wave model of light. Einstein revived the proposal that light consists of separate pieces of energy (particles). In 1905, Albert Einstein suggested that electromagnetic waves could only exist as discrete wave-packets. He called such a wave-packet the light quantum (German: das Lichtquant).

Many further experiments, including the Compton scattering of single photons by electrons, validated Einstein's hypothesis that light itself is quantized. In 1926 the optical physicist Frithi of Wolfers and the chemist Gilbert N. Lewis coined the name photon for these particles. Arthur H. Compton won the Nobel Prize in 1927 for his scattering studies. Thereafter, most scientists accepted that light quanta have an independent existence. Thus the photon concept was born, leading to a deeper understanding of the electric and magnetic field themselves(Ref:-en.wikipedia.org)

Photon replies to a bellboy in a hotel who asked him whether he has any luggage--- 'I am travelling light"-anonymous



Thomas Young's double-slit experiment in 1801 showed that light can act as a wave (en.wikipedia.org)

PROPERTIES OF A PHOTON

Photons have certain unique properties that explain what they are and why they behave in a certain way. These properties are stated below.

- A photon is a bundle (referred to as a "quantum") of electromagnetic energy. It is the basic unit that makes up all light.
- Not only is light made up of photons, but all electromagnetic energy (i.e. microwaves, radio waves, X-rays) is made up of photons.
- They have zero mass.
- They carry energy and momentum which are dependent on the frequency.
- Photons are always electrically neutral. They have no electrical charge.
- They can have interactions with other particles such as electrons.
- They are stable. Photons do not decay on their own. They can be destroyed or created by many natural processes.
- When in empty space, they travel at the speed of light.
- Light, which is comprised of protons ,behaves both like a wave and a particle

LIFE SPAN

How is a photon created or destroyed? When an electron emits a photon it is created instantaneously out of the vacuum. The electron in the high energy level falls into a lower energy-level after emitting a photon. There is no intermediate state when the photon is being constructed; it instantly comes into existence. Conversely, a photon is completely destroyed when it is absorbed by an electron. All its energy from the photon gets transferred to the electron, causing the electron to jumps to a new energy level.

Speed of light

Photons are created by fusion reactions whereby hydrogen atoms fuse into helium atoms inside the Sun's core. According to www.astronoo.com the energy produced by nuclear fusion is conveyed from the heart of the Sun by light particles or photons and heat. This particle, created in the solar core, transmits the light beam to Earth. The photon has to traverse the various layers of the Sun. The transit time of a photon from the core to the surface of the Sun is calculated as between **10 000** and**170 000** years based on collision.

It is now well known that it takes sunlight an average of **8 minutes and 20 seconds** to travel from the Sun to the Earth. Photons reaching us are stated to have been created tens of thousands of years ago, and it took that long for them to be emitted by the sun.

According to scientists photons travel through empty space at a speed of approximately 186,282miles (299,792 kilometers) per second, irrespective of what the electromagnetic wavelength is . In media other than a vacuum, the speed is reduced. Visible light is stated to travel more slowly through glass than through outer space. The ratio of the speed of the photons in a particular medium to their speed in a vacuum is called the **velocity factor** . This factor is always between 0 and 1 (or 0 and 100 percent), and it depends to some extent on the wavelength. We now know that the speed of light is an absolute that can't be broken by natural means, as it would needs an infinite amount of energy something that is not possible in our universe.

All matter originates and exists only by virtue of a force-----**Max Plank**

PHOTOELECTRIC EFFECT

Photons are basically the most visible portion of the electromagnetic spectrum. This was one of the major breakthroughs Einstein and Planck made about the nature of light. Because light is another form of energy it can be transferred or converted into other forms of energy . In the case of the photoelectric effect the energy of light photons is transferred through the photons bumping into the atoms of a given material. This causes the atom that is hit to lose electrons and thus make electricity. This link is what is behind the photoelectric effect that makes solar power possible.

PHOTONS AND QUANTUM PHYSICS

Photons have played a key role in the founding of quantum physics. Like all elementary particles, photons are currently best explained by quantum mechanics. Photons exhibit wave–particle duality, exhibiting properties of both waves and particles. In the Standard Model of particle physics, photons and other elementary particles are described as a necessary consequence of physical laws having a certain symmetry at every point in space-time. The intrinsic properties of particles, such as charge, mass and spin, are determined by this gauge symmetry. A single photon may be refracted by a lens and exhibit wave interference with itself, and it can behave as a particle with definite and finite measurable position and momentum. The photon's wave and quanta qualities are two observable aspects of a single phenomenon, and cannot be described by any mechanical model; a representation of this dual property of light, which assumes certain points on the wave front to be the seat of the energy, is not possible.(ref: en.wikipedia.org)

The study of the photons properties opened up a whole new class of fundamental particles called quantum particles.

APPLICATIONS

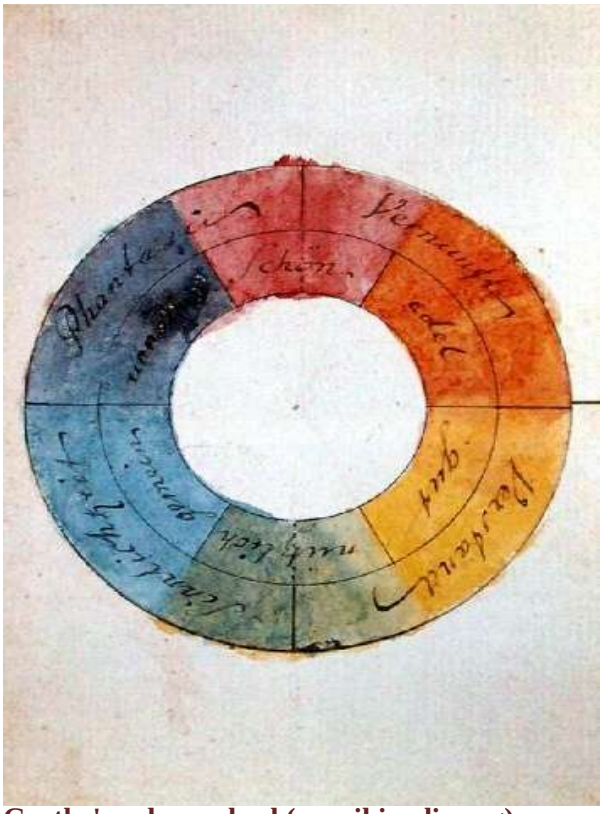
Photons also played a key role in the formulation of Einstein's theory of relativity. Existence of the photons helped us understand the importance of the speed of light and with it the understanding of the interaction of time and space that it produced. We also know that the photon concept has led to momentous advances in experimental and theoretical physics, including lasers, Bose–Einstein condensation, quantum field theory, and the probabilistic interpretation of quantum mechanics. It has been applied to photo chemistry, high-resolution microscopy, and measurements of molecular distances. Recently, photons have been studied as elements of quantum computers, and for applications in optical imaging and optical communication such as quantum cryptography. So without the photon we would not have the knowledge about our universe that we now possess.

Ref:- www.universetoday.com/ whatis.techtarget.com. / /en.wikipedia.org/ www.astronoo.com

I have no doubt that we will be successful in harnessing the sun's energy. If sunbeams were weapons of war, we would have had solar energy centuries ago.------**George Porter**

PERSONALITIES:GOETHE'S COLOUR WHEEL

-A poet's experiments with sunlight and colors



Goethe's colour wheel (en.wikipedia.org)

When we look at the list of great literary figures in the world who in the past had successfully combined their interest both in literature *and* science , as also other disciplines, the name quickly comes to mind is that of Johann Wolfgang von Goethe (1749-1832) . Equated in status to Shakespeare and Dante, he is considered to be the greatest poet, playwright, novelist and essayist in the German language in the modern era. Goethe was also a natural philosopher, diplomat and civil servant. It is, therefore, not difficult to think that a poet of his stature and fame developed a theory of color based on experiments with prisms and the observation of color in nature, particularly the colors of sun light.

Johann Wolfgang von Goethe (1749-1832)

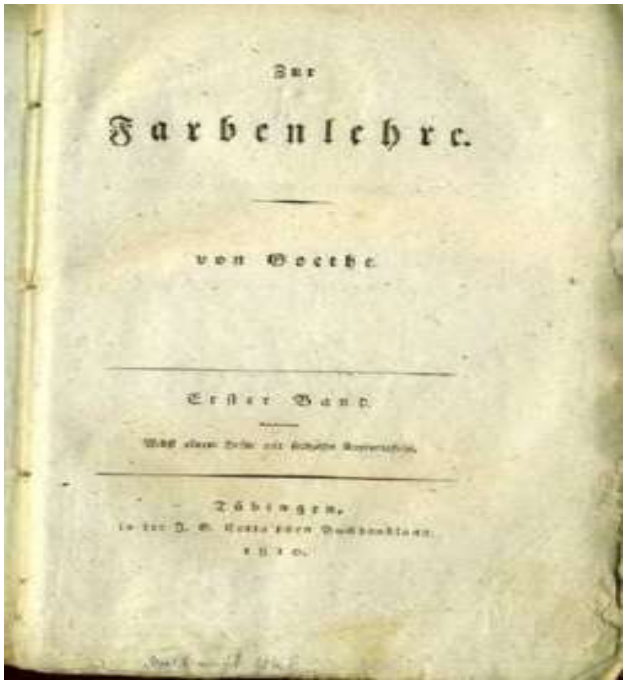
Notable works

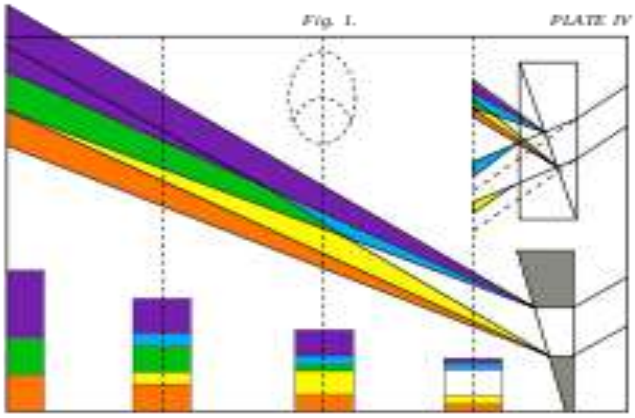
Faust; The Sorrows of Young Werther; Wilhelm Meister's Apprenticeship; Elective Affinities; "Prometheus"; Zur Farbenlehre; Italienische Reise; Westöstlicher Diwan

LITERARY WORKS

As mentioned Goethe's works span the fields of poetry, drama, literature, theology, humanism, and science. His body of work includes epic and lyric poetry written in a variety of styles; prose and verse dramas; memoirs; an autobiography; literary aesthetic criticism and novels (see box). The epic two-part drama Faust by Goethe is acclaimed as one of the greatest of world literature. His Faust, is also Europe's greatest long poem since John Milton's Paradise Lost and Dante's The Divine Comedy. Faust, was to be completed in stages, and only published in its entirety after his death. His works also include treatises on subjects relating to botany, anatomy, and color.

So dawn goes down today... Nothing gold can stay. -- **Robert Frost**


Zur
Farbenlehre.
von Goethe
Erster Band.
Tübingen.

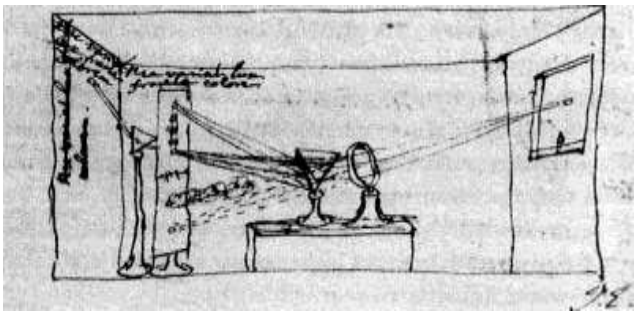


credit: www. wikipedia.org Optiks/www.homodiscens.com/

Light spectrum, from Theory of Colors. Goethe observed that with a prism, color arises at light-dark edges, and the spectrum occurs where these colored edges overlap.

Goethe's treatise on color

Theory of Colours (original German title Zur Farbenlehre) a treatise on the nature, function, and psychology of colors by Goethe is about the poet's views on the nature of colours and how these are perceived by humans. Published in 1810, it contains detailed descriptions of phenomena such as coloured shadows, refraction, and chromatic aberration.Goethe's book provides a catalogue of how colour is perceived in a wide variety of circumstances, Goethe observed that colors arise from the interaction of dark and light. According to him "Color itself is a degree of darkness. Light and darkness, brightness and obscurity, or if a more general expression is preferred, light and its absence, are necessary to the production of color… Color itself is a degree of darkness". *www.brainpickings.org* observes that ' perhaps his most fascinating theories explore the psychological impact of different colors on mood and emotion — ideas derived by the poet's intuition'.



Issac Newton (1704)-Experiments with Sunlight (Researchgate.net)

GOETHE VS NEWTON

In his treatise on color he departed from Newton's theory about the color spectrum by giving a psychological and philosophical account of the way we actually experience color as a phenomenon. He put forward the view that darkness is an active ingredient rather than the mere passive absence of light. It is said that because Goethe misinterpreted some experiments, he incorrectly thought that these experiments show Newton to be wrong.

"The purest and most thoughtful minds are those which love color the most."

— John Ruskin

Qualities of Light	Newton (1704)	Goethe (1810)
Homogeneity	White light is composed of colored elements (heterogeneous).	Light is the simplest most undivided most homogenous thing (homogeneous).
Darkness	Darkness is the absence of light.	Darkness is polar to, and interacts with light.
Spectrum	Colors are fanned out of light according to their refrangibility (primary phenomenon).	Colored edges which arise at light-dark borders overlap to form a spectrum (compound phenomenon).
Prism	The prism is immaterial to the existence of color.	As a turbid medium, the prism plays a role in the arising of color.
Role of Refraction	Light becomes decomposed through refraction, inflection, and reflection.	Refraction, inflection, and reflection can exist without the appearance of color.
Analysis	White light decomposes into seven pure colors.	There are only two pure colors – blue and yellow; the rest are degrees of these. Citation: (Theory of Colors, Volume 3, Paragraph
Synthesis	Just as white light can be decomposed, it can be put back together.	Colors recombine to shades of grey.
Particle or Wave?	Particle	Neither, since they are inferences and not observed with the senses.
Color Wheel	Asymmetric, 7 colors	Symmetric, 6 colors ***Credit:www.waldorfanswers.org/Goethe/Newton***

Analysts are of view that the observations on color made by both Newton and Goethe are correct. Newton experimented with pin hole and prism, whereby the colors of the entire spectrum could be visible together. *www.waldorfanswers.org/Goethe/Newton* pointed out that Goethe's experiment with the prism involves viewing a light and dark boundary, showing the "warm" colors (red, orange, yellow) spread over the light area and

in the other the "cool" colors (violet, blue, light blue) over the dark area. While Newton's concern was with the analysis of the color spectrum that of Goethe was with the qualities of how phenomena are perceived by the viewer. The two experiments can be unified by viewing a white line on a black background through the prism.

Goethe's theory on color was dismissed in general by the scientific community. However, some of the philosophers and physicists, including Arthur Schopenhauer, Kurt Gödel, and Ludwig Wittgenstein *reported to have shown interest in his unusual work. www.openculture.com mentions that* Ludwig Wittgenstein saw

There is some new thing created at the contact of photon and retina; some space created between rock and mind--**Kim Stanley**

Goethe's work as operating very differently than Newton's optics 'not as a scientific theory but rather as an intuitive schema'. Wittgenstein was stated to have commented on Goethe's work- "is really not a theory at all. Nothing can be predicted by means of it. It is, rather, a vague schematic outline----."According to Schopenhauer , however, "[Goethe] delivered in full measure what was promised by the title of his excellent work: data toward a theory of color. They are important, complete, and significant data, rich material for a future theory of color." It was a theory, Schopenhauer admits, that does not "[furnish] us with a real explanation of the essential nature of color, but really postulates it as a phenomenon, and merely tells us how it originates, not what it is."

As pointed out by analysts 'Goethe's scientific conclusions have, of course, long since been thoroughly demolished, but the intelligent reader of today may enjoy this work on quite different grounds: for the beauty and sweep of his conjectures regarding the connection between color and philosophical ideas; for an insight into early nineteenth-century beliefs and modes of thought; and for the flavor of life in Europe just after the American and French Revolutions'.

Ref: ***www.webexhibits.org/ mitpress.mit.edu/ www.webexhibits.org/en.wikipedia.org/://www.brainpickings.org/ www.waldorfanswers.org/GoetheNewton***

(Credit; quotefancy.com)

"Let me, O let me bathe my soul in colours; let me swallow the sunset and drink the rainbow."

— Kahlil Gibran

ART& ARCHITECTURE: THE SUN TEMPLE AT KONARK

Most ancient cultures worshipped the Sun. Hindus worship the Sun to this day, in a practice dating back to the Vedic times (1700-1100 BCE). Sun temples are, therefore, a part of the cultural and religious heritage of India. According to a blog published on 5-6-2013 in the website bharathgyan.wordpress.com the land which forms the Indian subcontinent today spans from 6.7 degrees North latitude to 37.1 degrees North latitude. In this wide span, a number of Sun temples are found, almost in a straight line around 23 degrees North latitude. 23.5 degrees North latitude is the Tropic of Cancer .

The Sun Temple at Konark is a 13th-century temple dedicated to the Sun in Odisha, India. The temple is located around 65 kms from the capital city of Bhubaneswar. The name Konark is an amalgamation of two words--*Kona* meaning corner or angle and Arka meaning the Sun. It is believed that the temple was built by king Narasimhadeva I of Eastern Ganga Dynasty around 1250 CE. The temple, being an important landmark in their coastal voyage was named 'The Black Pagoda' by European sailors. It is said that the temple was not completed as conceived because the foundation was not strong enough to bear the weight of the heavy dome. Local belief has it that it was constructed in entirety, however its magnetic dome caused ships to crash near the sea shore, and that the dome was removed and destroyed and that the image of the Sun God was taken to Puri.

MYTHOLOGY

According to mythology Lord Krishna's son Samba was suffering from leprosy due to a curse on his father. He underwent severe penance for 12 years at Mitravana near the confluence of Chandrabhaga River with the sea at Konark and ultimately succeeded in pleasing the God Surya (the Sun), the healer of all skin diseases, and was cured of his illness. In gratitude, he was said to have decided to erect a temple in the honor of the Sun. According to www.wikipedia.org the temple was originally built at the mouth of the river Chandrabhaga, but the waterline has receded since then.

The temple has been built in the form of a gigantic chariot of the Sun god, Surya. It has twelve pairs of elaborately carved stone wheels which are 3 meters wide and is pulled by a set of seven horses (4 on the right and 3 on the left). The temple follows the traditional style of Kalinga architecture. It is carefully oriented towards the east so that the first rays of sunrise strikes the principal entrance. The temple is built from Kondalite rocks.

"Here the language of stone surpasses the language of man."-Rabindranath Tagore

It is said that this colossal temple complex was too heavy for the soil on which it was built. The original temple had a main sanctum sanctorum (*vimana*), which was supposedly 229 feet (70 m) tall. Due to the weight of the super structure the 70 meter *shikhara* covering the sanctum as well as the roof of the dance pavilion collapsed in 1837 . Only the *jagamohana (audience hall)* with its large pyramidal roof rising in three tiers decorated with sculptures of musicians, dancers and maids *has survived.*

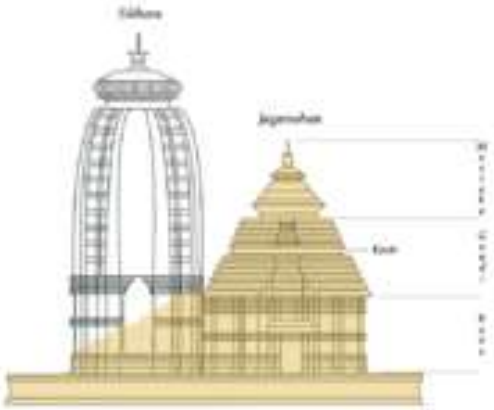


Figure 4 Original temple compared to the surviving structure (yellow) -en.wikipedia.org-

d. Among the structures, which have survived to the present day, are the dance hall (*Natya mandira*) and dining hall (*Bhoga mandapa*). The large structure of Konark Temple seen today is said to be actually the entrance of the main temple. Even in its ruined state it is a magnificent temple reflecting the mastermind of the architects that visualized and constructed it.

The sanctum and the *jagamohana* together stand on a common platform studded with an intricate wealth of decorative ornaments and sculptures, often of a highly erotic type. The sanctum displays images of the Sun-god in the three projections which are treated as miniature shrines. They are positioned in such a way to catch the sun's rays in the morning, noon and evening. Around the base of the temple there are images of animals, foliage, warriors on horses and other interesting structures. On the walls and roof of the temple erotic figures are carved. Two smaller ruined temples have been discovered nearby. One of them is called the Mayadevi Temple and is located southwest from the entrance of the main temple. It is presumed to have been dedicated to Mayadevi, one of the wives of the Sun god which has been dated to late 11th century, earlier than the main temple. The other one belongs to some unknown Vaishnava deity. Sculptures of Balarama, Varaha and Trivikrama have been found at the site, indicating it to be a Vaishnavite temple. Both temples have their primary idols missing.

The wheels of the temple are sundials which can be used to calculate time accurately to a minute including day and night.

Sun temple of Konark is considered to be a masterpiece of Orissa's medieval architecture. It is described as a massive conception of artistic magnificence and engineering dexterity. The Konark temple is widely known, not only for its architectural greatness, but also for the sophistication and abundance of sculptural work. The temple was granted World Heritage Site status by the UNESCO in 1984. The Sun Temple Museum is run by the Archaelogical Survey of India. The Konark Dance Festival organized here every year is a great attraction for tourists. The Konark Museum of the Archeological Survey of India has a good collection of

Architecture is an expression of our values---
Norman Foster

sculptures from the temple ruins.

HOW TO REACH

Konark is connected by good all weather roads. Regular bus services are operating between Puri and Bhubaneswar. Private tourist bus services and taxis are also available from Puri and Bhubaneswar. For internal transport, auto rickshaws and cycle rickshaws are available near the temple. Bhubaneswar is the nearest airport which is at a distance of 65 kms. The nearest railway stations are Bhubaneswar and Puri. Konark offers various government approved accommodations at Pantha Nivas, Traveller's Lodge, Inspection Bungalow and Yatri Nivas. Tourists can also stay in private hotels located at Konark, Puri & Bhubaneswar.

Ref: as i.nic.in › Monuments › World heritage Site://bharathgyanblog.wordpress.com/www.orissatourism.org/www.thekonark.in/ templenet.com/

chariot of the gods, Konak temple (Credit: ancient-origins.net)

ourworldknows.blogspot.com

Sun god, Konark (Credit; Getty images)

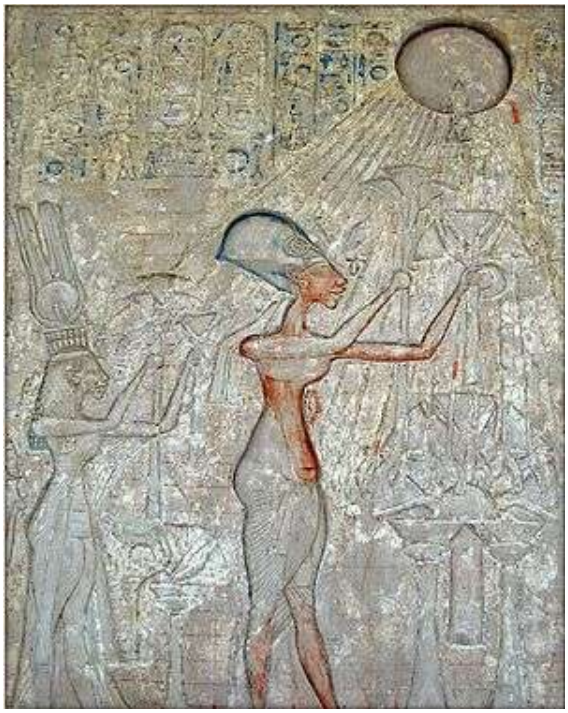
Whatever good things we build end up building us

---Jim Rohn

POEM: A HYMN TO THE SUN

A "hymn" is a poem or song made in praise of a divine deity or its personification. Those in praise and thanksgiving which were addressed to the Sun-god by orthodox Egyptian rulers under the XVIII dynasty are cited as good examples of hymns. The longest and best rendition of a composition known as **The Great Hymn to the Aten** (Aten- the disk, orb, sphere, globe of the Sun) is attributed to Pharoah Akhenetan (1375-1358 BCE). It is stated to be one of the surviving oldest forms of lyric poetry. The great hymn to the Aten is stated to exist as one copy only, carved in the entrance corridor of the tomb of Ay, the Chief Minister of Akhenaten (and later to become king after Tutankhamun's death), whereas, five copies of the lesser hymn to the Aten exist *(www.osirisnet.net).*

Described as the creator of everything Ra (Re) was known as the Sun- god of ancient Egypt . As the king of the gods of the Egyptian pantheon Ra was the patron god of the pharaoh. In the reign of, Amenhotep IV , the Aten became the central god of Egyptian state religion. The hymns suggest that Akhenaten considered Aten as the only god. Ra was equated with Aten in the great Hymn by Akhanetan. . Amenhotep IV is said to have changed his name to Akhenaten to reflect his close link with the new supreme deity.



Pharaoh Akhenaten and his family adoring the Aten (curtsey: en. wikipedia.com)

Head of Akhenetan (en.wikipedis.com)

Analytical studies of the hymns by experts reveal that Akhenaten praises Aten as 'the creator, giver of life, and nurturing spirit of the world'. It has been observed that 'Akhenetan's Hymn to the Sun extends the power of Sun from the natural world to the human world, from Egypt to beyond, encompassing all creation of earth and

Religion is the frozen thought of man out of which they build temples---**J.Krishnamurti**

sky'. Further, it is said that 'the hymn abounds in vivid imagery and striking turns of thought'.

Figure 5 Drawing of Egyptian inscription from XIV BC published in 1908

According to translation and analysis of the Hymn, the first two opening stanzas contain a symmetrical exposition of the relative power of the Sun as a divine deity through its effects on the human and natural world when he rises in the horizon and when he sets in the land of life. (Ref.www.sacredtexts.com).

Stanzas II & IV relates to exposition of Sun's power and generosity towards both the human and natural worlds. In Stanzas V& VI the Sun god is evoked as the source of fertility and the reproductive cycle in both the human and the natural worlds. Stanzas VII & VIII address the Sun as the sole creator of endless and limitless variety in the human and natural worlds. Stanza IX

O RA, who risest as Tem-Heraakhuti.

Thou art adored. Thy beauties are before my eyes, and thy splendour falleth upon my body.

Thou goest to thy setting in the Seqtet Boat with fair winds, and thy heart is glad. The heart of the Matet Boat rejoices.

Thou stridest over the heavens in peace, all thy foes being cast down.

The stars which never rest (i.e., the planets) hymn thee, and the stars which never vanish (i.e., the circumpolar stars) glorify thee as thou sinkest to rest in the horizon of Manu.

Thou art beautiful at morn and at eve, O thou Living Lord, the Unchanging One, my Lord. Homage to thee who risest as Ra and settest as Tem in beauty.

mentions that the Sun created Hapy (the Nile river god). There is a Nile in the sky and Sun causes it to rain so that agriculture may flourish. Summation of Sun's omnipotence and

If I had to choose a religion, the sun as the universal giver of lifewould be my God-**Napoleon Bonaparte**

limitlessness are mentioned in Stanza X. Stanza XI describes the Sun as - "You are the one God, shining forth from your possible incarnations as Aten, the Living Sun revealed like a king in glory . . ." In the concluding stanza-- Stanza XII, *the poem turns the power of the Sun over all the world to its presence to the power in the King's heart."And you are in my heart: there is no other who truly knows you but for your son, Akhenetan."*The King presents himself as the son of the Sun, and invokes Sun to "Lift up the creatures of earth for your Son/ who came forth from your Body of Fire!" (Ref.Beebalm.worldpress.com)

Figure 6Akhenaten depicted as a sphinx at Amarna

(Wikimedia .commons.org)

Akhenetan is stated to have built a city of Sun "Heliopolis" in honor of the Sun god. The cult centre of Aten was at the new city Akhetaten (modern Amarna); some other cult cities included Thebes and Heliopolis.

This ancient HYMN is said to be the first written record of monotheism in the world. The Hymn suggests that Akhenaten considered Aten as the only god. Akhenaten is said to have forbade the worship of other gods, a radical departure from the centuries of Egyptian religious practice.

According to him Aten was not the disc or orb of the sun (the Egyptian sun god Ra) but a universal spiritual presence.

Hymn to Aten

How manifold it is, what thou hast made!
They are hidden from the face (of man).
O sole god, like whom there is no other!
Thou didst create the world according to thy desire,
Whilst thou wert alone: All men, cattle, and wild beasts,
Whatever is on earth, going upon (its) feet,
And what is on high, flying with its wings.
(From the middle of the text)

You are in my heart,
There is no other who knows you,
Only your son, Neferkheprure, Sole-one-of-Re [Akhenaten],
Whom you have taught your ways and your might.
[Those on] earth come from your hand as you made them.
When you have dawned they live.
When you set they die;
You yourself are lifetime, one lives by you.
All eyes are on [your] beauty until you set.
All labor ceases when you rest in the west;
When you rise you stir [everyone] for the King,
Every leg is on the move since you founded the earth. (From the last part of the text, translated by Miriam Lichtheim) (en.wikipedia.com)

Agriculture was central to the Ancient Egyptian civilization and the ancient Egyptians seem to have been accomplished farmers. Their daily life was therefore fully dependent on the power of the Sun. As a result Sun worship became an integral part of their life. Recognizing the potentiality of the Sun to influence the life of his people Akhanaten tried to spread the belief amongst them that there is no god other than the Aten . . ." By evoking the Aten, he was perhaps alluding to the divine origin of the kings. After his death,

"Truth is like the sun. You can shut it out for a time, but it ain't going away."

— Elvis Presley

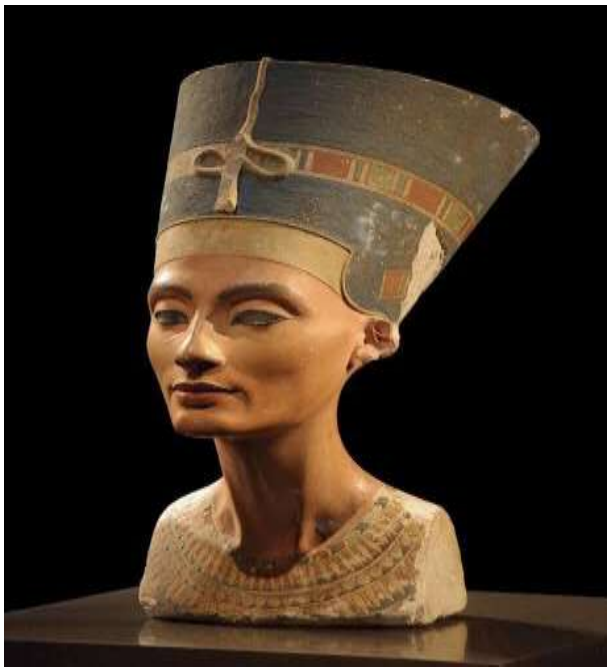
however, traditional religious practices were gradually restored.

References:-www.osirisnet.net/
Ref.www.sacredtexts.com/ en.wikipedia.com/ Beebalm.worldpress.com

Stela of the Great temple of the Aten showing the early form the Aten's names(Credit: en. wikipedia.org)

Small Temple of the Aten at Akhetate

(en.wikipeia.org)



Pharoah Amenhotep (twitter.com)

Sun God-image

TRAVEL: SEYCHELLES: THE LAND OF THE SUN, SEA AND SAND

-

Sudha Shrotria

'Unique by a thousand miles' says the publicity poster and indeed Seychelles lives up to it. It is one of the few places on earth that still remains unspoiled. An archipelago of 115 islands in the Indian Ocean, Seychelles is renowned for its silvery beaches and unique fauna and flora. The name invariably brings to one's imagination stories of hidden treasures and pirates, of magic and mystery, of golden sunshine, of mountains and tropical lush green vegetation.

Majority of the people live on Mahe, the largest island of Seychelles. Its capital Victoria, is the seat of the government and the centre of economic activity. A prominent landmark in Victoria is the replica of the Big Ben and side-walks where the local people sell their artifacts. Mahe is surrounded by a virtual treasure of beautiful beaches and contrasting topography. The Morne Seychellois National Park, the highest point at 900 meters above sea level, is a trekker's paradise. As the trails wind up through the rich flora, the view of the sea from above is breathtaking. *Anse Intendance,* one of the south-coast beaches boasts of a spectacular coconut palm, possibly the only one in the world which has a branch.

A great place to explore in Mahe is the Botanical Garden at Mt Fleuri. The offices of the Department of Environment are located within the Botanical Garden-an ideal place for officials to work -lush green surroundings, flowing streams, orchids, flamingos, giant land tortoises and rare species of Coco-de-mer (coconut of the sea) standing tall.

A short ride away from Mahe is the *Sainte Anne Marine National Park,* which protects more than 150 types of fishes. Some of the other islands- *Cerf, Ile Therese, Moyenne, Silhoutte and Round* are easily accessible from Mahe and ideal for snorkeling and discovering the world of corals in

"It is good to have an end to journey toward; but it is the journey that matters, in the end."

— Ernest Hemingway

different hues.

A trip to Seychelles would not be complete unless one visited Praslin, the second largest island of Seychelles. The Air Seychelles twin otter flights from Mahe to Praslin take only 15 minutes. Seven miles in length and two and a half miles in breadth, the island is generally flat. Scattered throughout the valley are the palm, takamaka, acacia, mango, bamboo, pineapple and banana trees. It boasts of *Vallee de Mai*, a World Heritage site known for its Coco-de-Mer and the

Black Parrot. The Coco-de-Mer is unique to Seychelles, found nowhere else in the world, its fruit can measure up to 2 ft long and weigh up to 20 kilos. Its ownership and possession is strictly regulated by law and a tourist needs permission to take it o out of the country. Besides the *Vallee de Mai* the main attraction of Praslin are its beautiful beaches, the most popular being *Cote d'Or* (Gold Coast) on the western shore and *Anse Lazio* on the northern tip. From *Baie St Anne* in Praslin, a half an hour ride by boat takes us to the fourth largest island of Seychelles –La Digue. An epitome of a tropical island –with its lush growth of coconut, casuarinas, breadfruit and native takamaka trees interspersed with black granite scattered along the shore is a rare sight.

With hardly any motor cars on the island, life on La Digue stands still. The tourists are often seen riding an Ox-driven cart to go around the island, while the more enterprising ones hire bicycles to explore the island. The small island boasts of some long white beaches with calm waters, protected by the granite rocks and coral reef circling the island.

The other fascinating islands are Curieuse, Cousin, Aride, Denis, Fregate and the Bird island. The Bird island is home to millions of Sooty Terns while Fregate, where Magpie Robin is found, is the most isolated of the granitic islands and life there has not changed much since the old plantation days.

A melting point of different cultures-French, English, Indian, African and Chinese, the Seychellois enjoy an easy life style and live in harmony with nature. In a fast changing world Seychelles still manages to remain unique and pristine.

GETTING TO SEYCHELLES

There are five direct flights from Mumbai to Mahe- Air Seychelles, Emirates, Etihad, Ethiopian and Kenyan Airlines. The temperature on Mahe varies from 24-30 degrees throughout the year. The best time to visit Seychelles is July and August. *(Note: The photographs above have been contributed by the author. She can be spotted in a few of them)*

Not all those who wander are lost."

— J.R.R. Tolkien

FOOD: SUN FOODS

Demands of home and work place make modern life somewhat rushed and stressful. Among other things those have also affected even the way we cook and eat food. Modern lifestyle forces us to reduce cooking at home to the minimum . With the availability of a number of time-saving gadgets like pressure cookers, gas burners, micro-wave ovens, induction cookers, food processors etc preparing food in modern kitchens, especially in cities, has become more and more technology-oriented and convenient. However, we still dependent on nature in preparing certain types of food items. Here we have included two simple items which are processed using the sun's energy.

Nature is a vast source of energy. We seldom notice that a surprising variety of foods can be processed under the sun. Drying and curing food items are simple methods of preservation of food. Drying different items of food materials like meat, fish, fruits and vegetables is very common across different cultures from ancient times. Drying helps in preserving food items, especially when their availability is abundant. It prevents wastage. Drying is a comparatively less expensive method of preservation as sun's energy is freely available in most parts of the world. Moreover, the techniques of preservation are simple, convenient and eco-friendly. Besides, the quality of food is mostly preserved.

Drying under sun is a practice still followed in different parts of India. Many times food items preserved during dry seasons help people, especially in the rural areas, tide over lean seasons. In fact, many poor families mostly dependent on preserved/prepared food items, especially during rainy season.

Drying vegetables like string beans, ladies' finger, bitter gourd etc is very common in India. Among the dried vegetables, dried bitter gourd fritters and green chilies have a special place in southern states like Kerala, Tamil Nadu and Karnataka. After drying under sun, they are deep-fried and eaten with rice and vegetables. We give you below recipe for making bitter gourd fries.

"Square meals often make round people."

— Joseph Cossman

SUN DRIED BITTER GOURD FRIES

curtsey: malabarkitchen.com

In Kerala we find a variety of bitter gourd which is somewhat special. Unlike the small dark green variety we find in Delhi and other parts of North India, the ones we generally get here are large, white and elongated, which is less bitter in taste. You can dry the vegetable by adding different spices. But in my mother's ancestral home it used to be made without adding any. For drying you need two to three bitter gourds, a spoonful of turmeric powder, salt-as desired, two cups of water, and required quantity of oil for deep frying.

The bitter gourds need to be cut into thin slices (not too thin as the rings get shrunk when dried) along with their seeds. Thereafter, water needs to be boiled in a pan and turmeric powder and salt are added. When it boils well, bitter gourd rings can be added and cooked for 3-4 minutes only. Care should be taken that the rings are still somewhat stiff when taken out and not over-cooked. Drain the water and spread the bitter gourd rings on a cotton cloth. Keep overnight. Next 3-4 days

allow them to get dried under hot sun until the bitter gourd rings are fully dried and crisp. Heat oil in a pan and deep fry the rings.

BROAD BEANS PICKLE

The state of Bihar in India is home to a variety of fruits and vegetables. If you care to drive from Patna towards Gaya via Bihar Sheriff one could see mounts of fresh vegetables on both sides of the road. Fruits like banana , Guava are in abundance. People of Bihar have an ingenious way of preserving seasonal fruits and vegetables by making pickles out of them for short periods. Unlike pickles made elsewhere which do not require placing them under sun, these pickles are placed under sun to enable them to ferment faster and keep them germ-free.

With the start of winter, different kinds of broad beans are available in Bihar like white/ green long and broad ones and green short/small ones. I have come across a beautiful broad green variety with purple borders in Patna. The one mostly used to make pickles is the long dark green variety.

In some of the families I know in Bihar *Sem Achar* is made by a very simple method by adding minimum spices. For half kilo of beans (long dark green variety) you need two table spoons of coarsely ground mustard seeds, one teaspoon turmeric powder and chili powder each, half-cup mustard oil and salt to taste.

To start making the pickle the broad beans ought to be washed thoroughly, cleaned and dried. In this method the bean is allowed to remain as such; stalks on both ends are not removed.

www.jaisiyaram.com

Take 3 to 4 cups of water in a pan and place it on the stove for boiling. When the water starts boiling, add the full beans into it, cover it to cook for 3-4 minutes. Care should be taken that the beans are not over cooked. They ought to remain somewhat stiff. Drain out the water. Dry the beans with a clean cloth. Thereafter. spread and place them on a clean dry cotton cloth to remove moisture. When the beans are fully dry, place them in a big bowl. Add yellow mustard powder, salt, turmeric powder, red chili powder and mustard oil. Mix well. Put the mixture in a large, clean glass jar and shake well. Place the jar under sun for 3-4 days. Keep shaking the pickle once in a while. The pickle is ready for use. It may be noted that the pickle should be consumed within a short time. The pickle can be taken with *roti* and vegetable preparations. It may be noted that the above items mentioned have usually high salt content. Salt input therefore, could be adjusted, if needed. Salt in the meal as a whole could also be adjusted in such a way that the overall salt content is not increased. The merit in these two preparations is that no added (chemicals)/preservatives are used.

"Don't dig your grave with your knife and fork."
— English Proverb

ASTRONOMY: BEYOND OUR SOLAR SYSTEM

This space we declare to be infinite... In it are an infinity of worlds of the same kind as our own--- Giordano Bruno (1584)

It is incredible that for over a long period of time most of us were under the notion that our solar system is the only one of its kind. In fact, for many thousands of years, people with a few exceptions, did not recognize or understand the concept of the Solar System at all. With the dawn of the space age and development of sophisticated space investigation devices, more and more information about the existence of other solar systems has started coming to us.

EVOLUTION OF THE HELIO-CENTRIC VIEW

Today we know that the Solar System is located in the Milky Way, within the spiral galaxy, with a diameter of about 100,000 light-years, containing The milky Wayabout 200 billion stars. We also know that for centuries together, the earth was thought to be stationary at the centre of the universe, although some of the ancient Greek had speculated on a heliocentric view of the cosmos. Nicolas Copernicus was the first to develop a helio-centric view with the aid of mathematic calculations in the 15th century. In the 17th century, efforts of made by Galileo Galilee, Johannes Kepler, and Isaac Newton led to the gradual acceptance of the idea that the Earth moves around the Sun and that the planets are governed by the same physical laws that govern the Earth. The invention of the telescope led to the discovery of other planets and their moons. Improvements in the telescope and the use of unmanned spacecrafts have enabled exploration beyond the known frontiers of space.

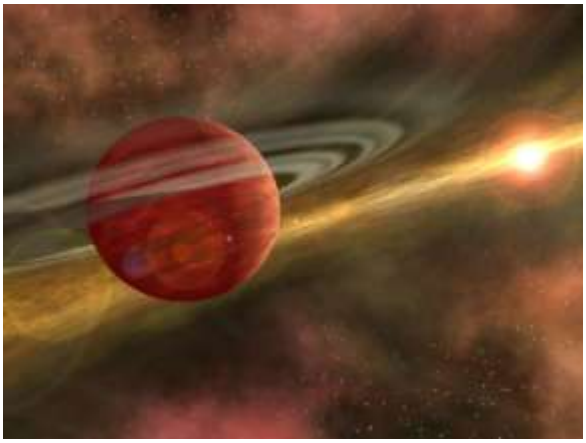
THE EDGE OF THE SOLAR SYSTEM

Today we know that the solar system is made up of the Sun and everything that orbits around it, including planets, moons, asteroids, comets and meteoroids. According to www.space.com

'it extends from the sun, and goes past the four inner planets, through the Asteroid Belt to the four gas giants and on to the disk-shaped Kuiper Belt and far beyond to the giant, spherical Oort Cloud and the teardrop-shaped heliopause. Scientists estimate that the edge of the solar system is about 9 billion miles (15 billion kilometers) from the Sun'.

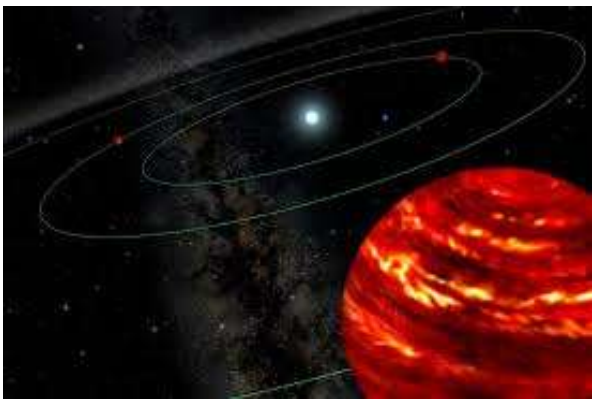
FORMATION OF THE SOLAR SYSTEM

Scientists are of view that our solar system formed from a giant, rotating cloud of gas and dust known as the solar nebula, which collapsed due to its gravity. While spinning faster it flattened into a disk, with most of the material being pulled towards the center to form the sun. Other particles within the disk collided and stuck together to form asteroid-sized objects, some of which combined to become the asteroids, comets, moons and planets. Most of the lighter elements, such as hydrogen and helium were swept away by the solar winds from the innermost planets, leaving behind mostly small more rocky worlds. The outer regions where the solar wind was much weaker transformed into gas giants made up mostly of hydrogen and helium.



The youngest exo-planet yet discovered is less than 1 million years old and orbits Coku Tau 4, a star 420 light-years away (Credit NASA)

The sun being the largest object in our solar system, contains 99.8 percent of the mass of the solar system. It sheds most of the heat and light that makes life possible on Earth and possibly elsewhere. Planets orbit the sun in oval-shaped paths .



Astronomers capture the first images of a newly discovered solar system (credit:www.llnl.gov)

EXO PLANETS

An exo-planet or extra-solar planet is a planet that orbits a star other than the Sun. In the sixteenth century the Italian philosopher Giordano Bruno, an early supporter of the Copernican theory that Earth and other planets orbit the Sun (helio-centrism), put forward the view that the fixed stars are similar to the Sun and are likewise accompanied by planets.

In the eighteenth century the same possibility was mentioned by Isaac Newton in the "General Scholium" that concludes his *Principia*. Making a comparison to the Sun's planets, he wrote "And if the fixed stars are the centers of similar systems, they will all be constructed according to a similar design and subject to the dominion of *One*."

For centuries philosophers and scientists supposed that extra-solar planets existed, but there was no way of detecting them or of knowing their frequency or how similar they might be to the planets of the Solar System. Various detection claims made in the nineteenth century were rejected by astronomers.

> If we knew exactly what to expect throughout the Solar System, we would have no reason to explore it. — **Paul (William) Anderson**

DETECTION

The Sun is one of about 200 billion stars (or perhaps more) just in the Milky Way galaxy alone. Using regular visible light telescopes, planets are very hard to see in the glare of a star. Using infrared space telescopes, the planets shows up much more clearly, the reason is that planets around other stars are really hard to find. Planets shine only by the light they reflect from the star they orbit, and they don't reflect much light at that. And the stars, along with any planets under their control, are so far away that picking out a faint planet near a distant star is very difficult. Brightness of star dips as planets passes between it and Earth.

After that, astronomers started detecting planets through several other methods as well. For example, if the orbit of a planet happens to be aligned so that planet occasionally travels in front of the star from our perspective on Earth, it blocks some of the light. Even though the planet is tiny compared to the star, extremely sensitive instruments can measure the tiny change in brightness. NASA's Kepler mission used this technique to identify hundreds of stars that may have planets. Astronomers are observing these stars more carefully to confirm the presence of the candidate planets.

Various detection claims made in the nineteenth century were rejected by astronomers. The first confirmed detection came in 1992, with the discovery of several terrestrial-mass planets orbiting the pulsar PSR B1257+12. The first confirmation of an exo-planet orbiting a main-sequence star was made in 1995, when a giant planet was found in a four-day orbit around the nearby star 51 Pegasi. Some exo-planets have been imaged directly by telescopes, but the vast majority have been detected through indirect methods such as the transit method and the radial-velocity method. Over 2000 exo-planets have been discovered since 1988 (2047 planets in 1296 planetary systems as of 12, January, 2016.

Extra solar systems

The Alien solar systems with multiple planets appear to be common in our galaxy, but most of them are quite different than our own, a new study finds. NASA's Kepler Space Telescope detected 1,235 alien planet candidates in its first four months of operation. Of those, 408 reside in multiple-planet systems, suggesting that our own configuration of multiple worlds orbiting a single star isn't so special. So far, astronomers have found more than 500 solar systems and are discovering new ones every year. Given how many they have found in our own neighborhood of the Milky Way galaxy, scientists estimate that there may be tens of billions of solar systems in our galaxy, perhaps even as many as 100 billion.

According to www.space.com the discovery of exoplanets has intensified interest in the search for extraterrestrial life. There is special interest in planets that orbit in a star's habitable zone, where it is possible for liquid water (and therefore life as we know it) to exist on the surface. The study of planetary habitability also considers a wide range of other factors in determining the suitability of a planet for hosting life. NASA and other agencies are looking for a special kind of planet: one that's the same size as Earth, orbiting a sun-like star in the habitable zone. The habitable zone is the range of distances from a star where a planet's temperature allows liquid water oceans, critical for life on Earth. The earliest definition of the zone was based on simple thermal equilibrium, but current calculations of the habitable zone include many other factors, including the greenhouse effect of a planet's atmosphere. This makes the boundaries of a habitable zone "fuzzy."

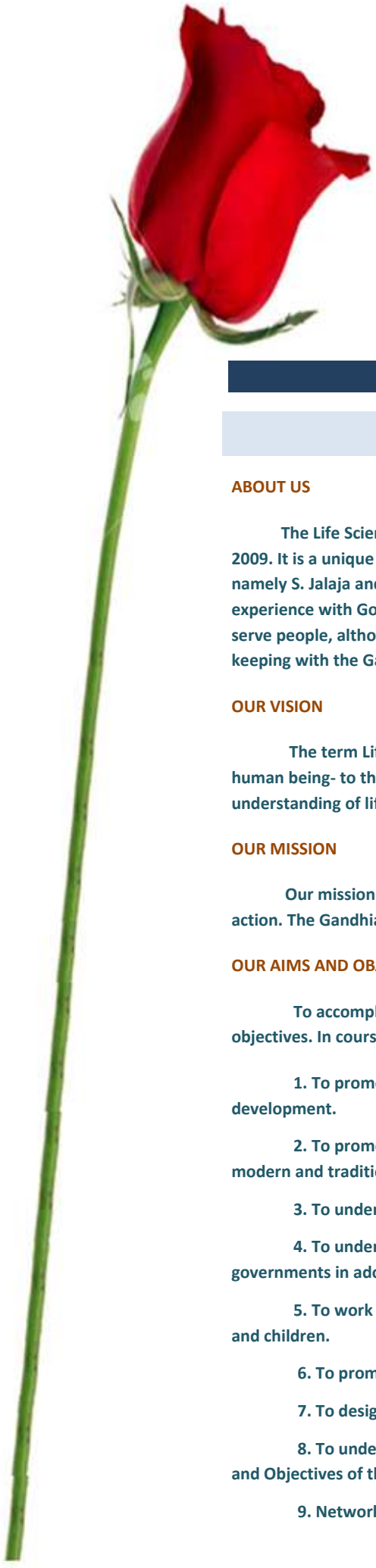
Whether this estimate is correct and how similar other solar systems are to ours, remain to be seen. It has only been a few years since the first solar system apart from ours was detected. Other solar systems are still extremely difficult to study, so this whole subject is still in its infancy.

Ref: www.space.com/ spaceplace.nasa.govt

I think we have a good chance of surviving long enough to colonize the solar system------ **Stephen Hawking**

LIFE STREAM is a quarterly magazine on holistic life published by a group of people who are committed to spreading the message of living in harmony with nature.

EXECUTIVE EDITOR	S.JALAJA
CONSULTING EDITOR	ANP SINHA
ASSOCIATE EDITOR	SUDHA SHROTRIA
EDITORIAL COMMITTEE	S.JALAJA, ANP SINHA, SUDHA SHROTRIA
COVER DESIGN	UNNI WARIYAR
PAGE DESIGN	ANP SINHA
PHOTOS/PICTURES	SUDHA SHROTRIA, VISHAKH, INTERNET
WORD PROCESSING	LIFE SCIENCE TEAM
CONTACT	sjalaja@hotmail.com
WEB SITE	http://www.lifesciencefoundation.in/



LIFE SCIENCE FOUNDATION

SERVICE IN TRUSTEESHIP

ABOUT US

The Life Science Foundation is a Not- for- Profit Public Charitable Trust registered on 30th December, 2009. It is a unique initiative by two officers belonging to the Indian Administrative Service (Bihar cadre) namely S. Jalaja and A.N.P. Sinha (IAS-1974) who have retired as Secretaries to Government of India. Their long experience with Governments at the National and State levels have instilled in them the will to continue to serve people, although from a different platform. Service through the medium of a public charitable Trust is in keeping with the Gandhi's ideal of Trusteeship.

OUR VISION

The term Life Science encompasses all aspects of life from Right to life- an inalienable right of every human being- to the interconnectedness of the entire web of life. Our vision, therefore, is to promote holistic understanding of life and its purpose, and improvement of quality of life of all.

OUR MISSION

Our mission is to improve quality of life through policy formulation, applied research and real life action. The Gandhian ideals of Sarvodaya and Trusteeship will be the guiding spirits.

OUR AIMS AND OBJECTIVES

To accomplish the above Vision and Mission, the Foundation will initially have the following aims and objectives. In course of time, more could be included:

1. To promote strategic thinking and suggest policy interventions on holistic and sustainable development.

2. To promote holistic health care system based on simple living, preventive healthcare, and both modern and traditional health systems.

3. To undertake studies, research and action-oriented projects pertaining to holistic life.

4. To undertake pilot projects of good governance including e-governance and eventually support the governments in adopting and up scaling successful pilots. .

5. To work towards promoting quality of life of vulnerable sections of population, including women and children.

6. To promote all- round human resource development.

7. To design self- sustaining livelihood projects which minimise subsidies and donor- dependency.

8. To undertake other activities which are conducive to pursuit and fulfilment of the vision, Mission and Objectives of the Foundation.

9. Network with institutions and agencies to achieve the above objectives.